

EXTERNAL MEASUREMENTS AND ALLOMETRY OF SOUTHERN SEI WHALE FOETUSES

AKITO KAWAMURA¹⁾

ABSTRACT

External measurements and allometry of a total of 89 southern sei whale foetuses 64.0-366.0 cm in length are reported. The animals were collected during the Antarctic whaling season of 1967/68. This study was conducted to obtain numerical data on sei whale foetuses and some of their allometric features. The number of ventral grooves increased gradually after attaining *ca.* 100 cm long, and their average numbers in the largest size groups were 57.7 (♀) and 58.8 (♂). The *a*- and *b*-values as determined by the allometry formula were 0.02-9.8 and 0.93-1.18, respectively. Various growth data indicated the possibility of a monophasic-like development, with significant evenness. However, due to the limited number and size coverage of the animals, it is difficult to conclude whether the southern sei whale foetus actually shows monophasic allometry. The body proportions of the sei whale foetus showed isometric characteristics similar to those observed in the adult animal.

Key words: allometry, sei whale, foetus, Antarctic

INTRODUCTION

Exploitation of southern sei whales (*Balaenoptera borealis*) began in 1906 (Horwood, 1986, 1987), and the total number of sei whales caught in the Antarctic finally reached 171,000 (Horwood, 1986). In contrast to the other large rorqual species, heavy exploitation of the sei whale is considered to have taken place within a relatively short period, although the total catch was actually quite large.

Matthews (1938) reported body proportions of adults and foetuses of southern sei whales mainly from South Georgian waters, for a total of 55 specimens. Compared with fin whale foetuses (e.g. Ohsumi, 1960), little information is available on the growth of southern sei whale foetuses.

During the Antarctic whaling season of 1967/68, the author measured body proportions of sei whale foetuses. Since only sporadic observation was possible,

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the data for specimen number and body length are somewhat inadequate. However, the data here should facilitate biological study of the sei whale since only mean values for body proportions of sei whale foetuses are available in the literature (e.g. Matthews, 1938). This study was conducted to determine allometric features of southern sei whale foetuses and provide additional data on body measurements.

MATERIALS AND METHODS

The animals were caught by catcher boats associated with the whaling factory ship *Nisshin Maru* of Taiyo Gyogyo K.K. During the 1967-68 season, whaling was conducted in the western half of the Indian Ocean sector of the Antarctic, particularly in the quadrant including Crozet, Kerguelen and Heard Islands (see Kawamura 1974, Fig. 4).

The data for the foetuses are given in Table 1. Body lengths ranged from 64.0 to 366.0 cm. *Whale Numbers* given in Appendices II-III correspond to numbers registered in the catch logs compiled by the Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, Government of Japan.

The foetuses were measured using a handy flexible rule as long as 2.0 m. This might have caused a slight curve in scaling along the body arc for some long measurements, but no corrections were made. The measurement numbers in Appendices II-III agree with those by Mackintosh and Wheeler (1929), and some minor additions are indicated under the alphabetical headings (Fig. 1 and Appendices I-III). Ventral groove number was counted at the line connecting the anterior base of both flippers. In smaller foetuses, however, the ventral grooves were sometimes obscure or even completely absent.

TABLE 1. DATA ON SEI WHALE FOETUSES OBTAINED DURING THE ANTARCTIC SEASON OF 1967/68.

	Male	Female
Period of data	15/xii/1967 ~ 10/iii/1968	18/xii/1967 ~ 6/iii/1968
Range of body lengths (cm)	64 ~ 355	100 ~ 366
Mean body length (cm)	193.7	208.7
No. of animals measured per size group		
100 cm	3	1
101 ~ 200 cm	20	24
201 ~ 300 cm	13	17
301 ~ 400 cm	3	8
Total	39	50

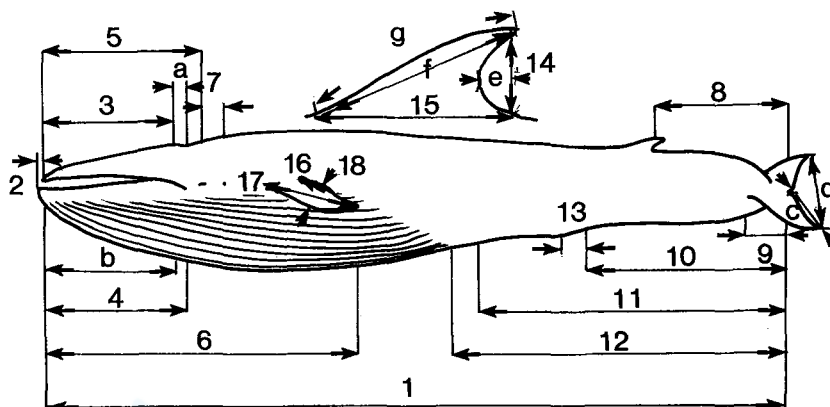


Fig. 1. Positions of external measurements of southern sei whale foetuses. For numbers see Appendix I.

RESULTS AND DISCUSSION

The number of ventral grooves increased with increased body length. In a 64.0 cm long foetus a conspicuous furrow-like structure was observed near the anterior base of the flippers. These furrows were clearly separated from the main system of ventral grooves, and became clearer in a 87.0 cm long animal. Six to ten such furrows were counted on both sides of the body. Since the ventral grooves in fin whale foetuses develop at 60.0 cm long (Ohsumi, 1960), the above-mentioned furrows may eventually develop into ventral grooves as the animal grows. The number of ventral grooves of the main system varied among individuals, but it generally increased gradually as the foetus grew (Table 2). The average numbers of ventral grooves in the 300-400 cm size group were 57.7 (male) and 58.8 (female), but the averages in fully mature adults are 47 (male) and 49 (female) (Matthews, 1938, Table XII). The difference between grown animals (Matthews, 1938) and foetuses of the present study is presumably due to the counting methods used, for instance if a different criterion was applied for counting the furrow-like structures.

The increase in the number of ventral grooves becomes gradual after the animal attains a body length of about 100 cm. In fin whale foetuses, Ohsumi (1960) reported 115 cm as the length at which development of ventral grooves may be complete. This finding, along with the above averages of 57.7 and 58.8 in 300-400 cm long sei whale foetuses, indicate increase in number of ventral grooves is nearly at the end of development.

TABLE 2. NUMBERS OF VENTRAL GROOVES IN SEI WHALE FOETUSES.¹⁾
AVERAGES APPEAR IN PARENTHESES.

Body length (cm)	Male	Female
~ 100	31 ²⁾	No data
101 ~ 200	41 - 63 (51.8)	38 - 58 (50.0)
201 ~ 300	43 - 58 (52.2)	46 - 66 (55.8)
301 ~ 400	54 - 60 (57.7)	50 - 63 (58.8)

1) Faint furrows similar to ventral grooves at the anterior base of flippers were excluded.

2) Data for one animal.

TABLE 3. *a*- AND *b*-VALUES AS DETERMINED FROM $y = a \cdot x^b$ FOR PRINCIPAL MEASUREMENTS IN MALES OF SEI WHALE FOETUSES. FEMALES GENERALLY SHOWED A PLOT DISTRIBUTION SIMILAR TO MALES, AND ONLY THE VALUES FOR MEASUREMENT NOS 10 AND 12 ARE GIVEN FOR FEMALES.

No. of proportion measurement ¹⁾	<i>a</i>	<i>b</i>	Correlation coefficient	Total number of measurements
Male				
3	0.082	1.052	0.9912	38
4	0.169	1.023	0.9946	35
5	0.176	1.004	0.9930	36
6	0.422	1.006	0.9973	38
8	0.209	1.042	0.9939	38
9	0.136	0.968	0.9530	39
d	0.207	0.995	0.9542	37
10	0.231	1.025	0.9937	39
11	0.432	1.009	0.9957	38
12	0.886	0.931	0.9904	37
13	0.072	0.990	0.9846	37
14	9.395	1.186	0.9412	36
15	0.022	1.154	0.9497	30
17	0.079	1.083	0.9941	37
Female ²⁾				
10	0.212	1.039	0.9911	50
12	0.928	0.925	0.9924	49

1) For measurements see Fig. 1 and Appendix I.

2) Females showed slight difference from males in these two measurements.

Measurements of relative growth of the sei whale foetuses are shown in Fig. 2, and the related data are given in Table 3. Comparing the present results on sei whale foetuses with those of Matthews (1938, Table V) for post-natal sei whales, the maximum difference in terms of percent proportions ranged $-4.04 \sim +3.1$ in males and $-3.25 \sim +2.91$ in females, while most were within the range of $-1.76 \sim +1.61$.

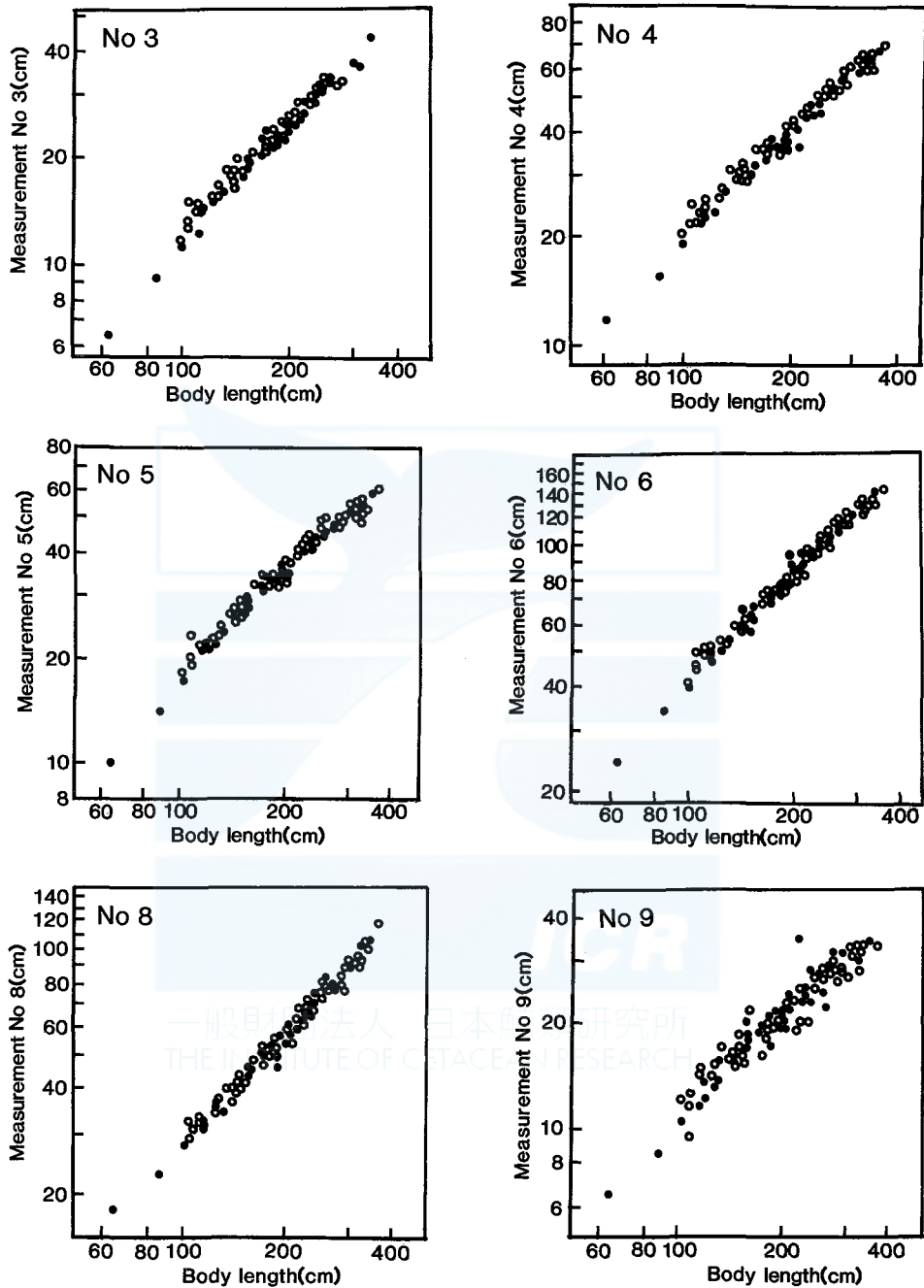


Fig. 2. Scatter plots of external measurements on body length for southern sei whale fetuses. No allometric phase was apparent within the size ranges examined. Closed circle indicates male, and open circle female. For measurements see Fig. 1 and Appendix I.

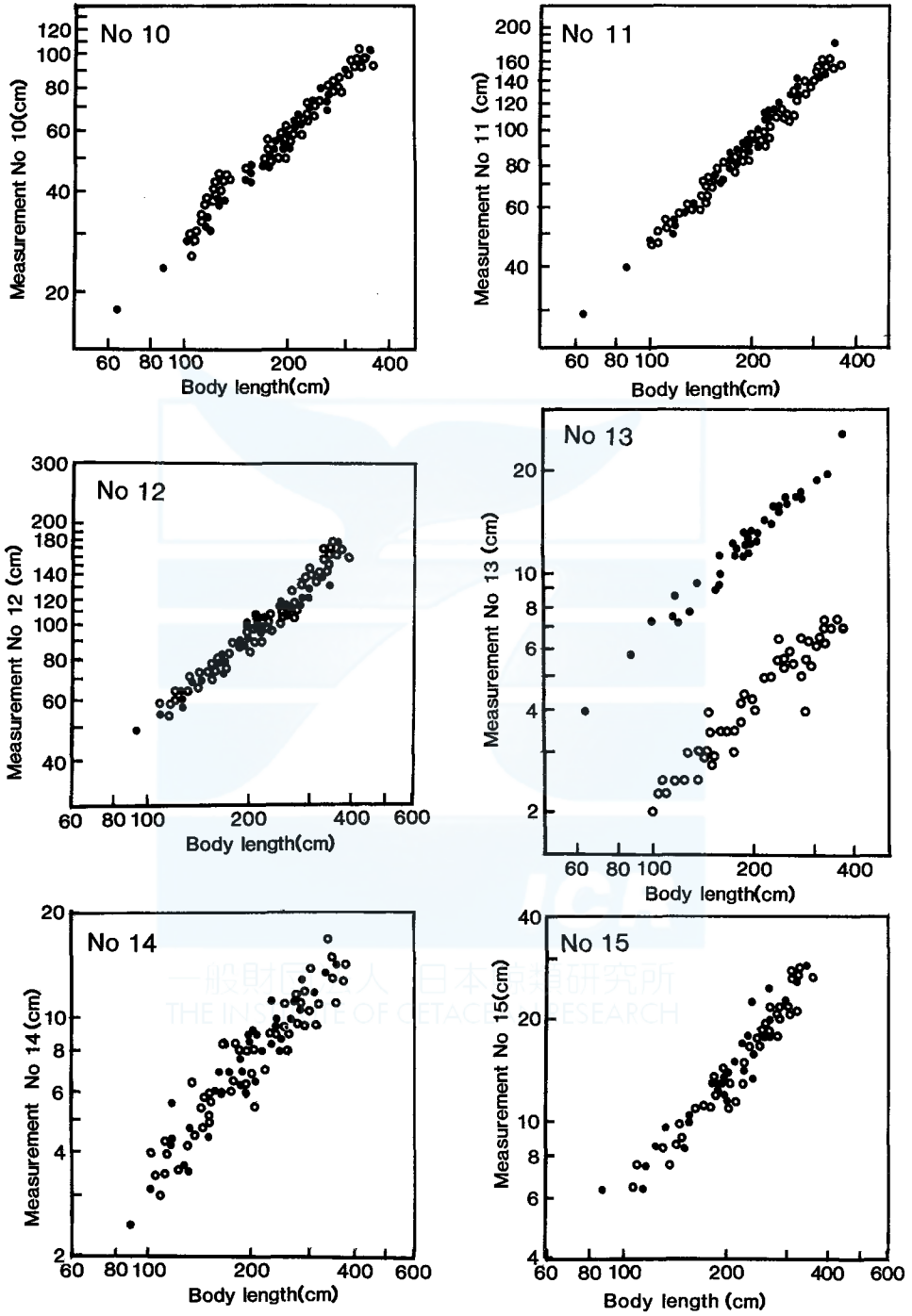


Fig. 2. (Continued)

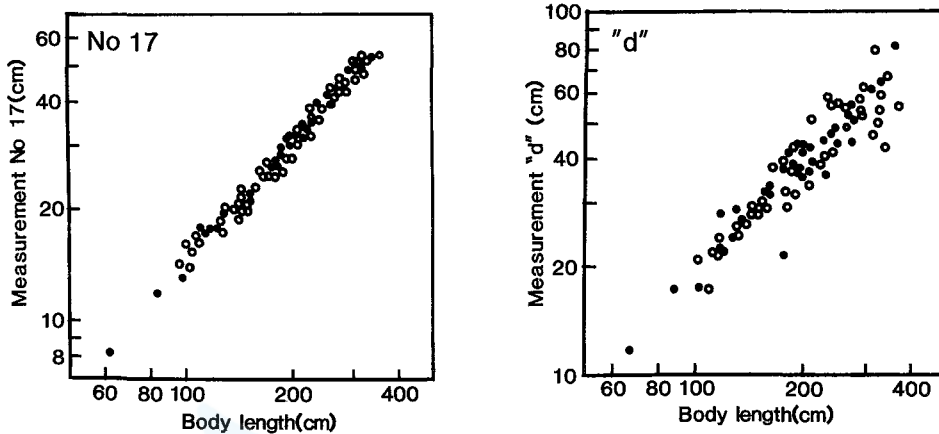


Fig. 2. (Continued)

The scatter in Fig. 2 demonstrates extremely similar or even the same functional patterns in both males and females. Although some signs suggesting possible change in the allometric phase at a length somewhere around 100 cm can be observed in Fig. 2 (e.g. Nos 4, 8, 9, 10, 13, 14 and 17), the signs for recognizing the allometric phase are obscure. The correlation coefficients for measurements No. 3 through No. 15 in male sei whale foetuses (Fig. 2) were within the range of 0.94-0.99, with high significance ($p < 0.001$). In measurements No. 10 and No. 12 in females, in which greater but still small differences from males were evident, the correlation coefficients were significant, with values of 0.991 and 0.992, respectively ($p < 0.001$). Monophasic-like characteristics in the allometry of sei whale foetuses are thus indicated at the size range of *ca.* 60-400 cm. Vikingsson (1988) found a relatively isometric growth for adult sei whales caught in Icelandic waters.

The a - and b -values of the allometric formula, $y = ax^b$, were in the range of 0.02-9.40 and 0.93-1.19, respectively (Table 3). In foetuses of the southern fin whale, Ohsumi (1960) found diphasic allometry in many cases, with a -values (α in Ohsumi, 1960) of 0.82-1.20 as determined by the allometry formula, and critical points mainly at body lengths of *ca.* 100-120 cm.

Due to the limited data for sei whale foetuses shorter than 100 cm and longer than 400 cm, it was difficult to determine whether the allometric phase actually occurs during the prenatal period. So far as the present results are concerned, southern sei whale foetuses appeared to exhibit monophasic allometry. However, the results cannot be considered conclusive. Matthews (1938) concluded that in the sei whale, growth is "much more evenly distributed throughout the body", and a "marked differential growth in favour of the anterior region does not occur to anything like the extent that it does in the larger whales".

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Appendix I. External body measurements.

1. Total length (mm)
2. Lower jaw, projection beyond tip of snout
3. Tip of snout to anterior margin of blow hole
 - a. Length of blow hole
4. Tip of snout to angle of gape
 - b. Tip of snout to angle of gape, inside
5. Tip of snout to center of eye
6. Tip of snout to tip of flipper
7. Center of eye to center of ear
8. Notch of flukes to posterior emargination of dorsal fin
9. Width of flukes at insertion
 - c. Tail flukes, notch to tip
 - d. Spread of tail flukes, tip to tip
10. Notch of flukes to center of anus
11. Notch of flukes to umbilicus
12. Notch of flukes to end of ventral grooves
13. Center of anus to center of reproductive aperture
14. Vertical height of dorsal fin
15. Length of base of dorsal fin
 - e. Dorsal fin, posterior depression
 - f. Anterior base to tip of dorsal fin, straight
 - g. Anterior base to tip of dorsal fin along emargination
16. Flipper, tip to axilla
17. Anterior end of lower border to tip of flipper
18. Greatest width of flipper
19. Diameter of umbilical cord at base
20. Length of penis

Appendix II. External measurements and percent body proportions for the foetuses of male sei whale. December 15, 1967-March 10, 1968. Antarctic. For measurements see Fig. 1 and Appendix I.¹⁾

Whale number	261	1330	320	990	316	559	1029
Date of catch	25xii67	18iii68	29xii67	2ii68	28xii67	13i68	2ii68
Body length(m)	16.5	15.2	15.6	14.7	15.3	15.4	15.6
No. of Ventral grooves ²⁾	-	31	41	51	47	53	49
Measurements							
1.	640	870	1,004	1,155	1,165	1,170	1,270
2.	-	-	7	-	-	-	-
	-	-	0.7	-	-	-	-
3.	65	92	116	142	142	148	152
	10.2	10.6	11.6	12.3	12.2	12.6	12.0
a.	-	15	-	27	-	29	33
	-	1.7	-	2.3	-	2.5	2.6
4.	120	160	198	230	237	240	240
	18.8	18.4	19.7	19.9	20.3	20.5	18.9
b.	-	135	-	208	-	-	225
	-	15.5	-	18.0	-	-	17.7
5.	103	143	177	215	215	228	225
	16.1	16.4	17.6	18.6	18.5	19.5	17.7
6.	269	370	433	510	532	543	547
	42.0	42.5	43.1	44.2	45.7	46.4	43.0
7.	-	59	-	86	-	-	87
	-	6.8	-	7.4	-	-	6.9
8.	185	230	280	327	313	315	360
	28.9	26.4	27.9	28.3	26.9	26.9	28.3
9.	65	85	104	115	137	120	130
	10.0	9.8	10.4	10.0	11.8	10.3	10.2
c.	-	95	-	-	-	-	-
	-	10.9	-	-	-	-	-
d.	120	175	175	225	282	220	240
	18.8	20.1	17.4	19.5	24.2	18.8	18.9
10.	175	230	280	305	323	300	370
	27.3	26.4	27.9	26.4	27.7	25.6	29.1
11.	290	400	483	513	548	525	585
	45.3	45.9	48.1	44.4	47.0	44.8	46.1
12.	-	500	575	622	655	595	700
	-	57.5	57.3	53.9	56.2	50.9	55.1
13.	40	58	73	75	87	73	78
	6.3	6.7	7.3	6.5	7.5	6.2	6.1
14.	-	25	32	57	44	43	37
	-	2.9	3.2	4.9	3.8	3.7	2.9
15.	-	65	-	64	-	75	85
	-	7.5	-	5.5	-	6.4	6.7
e.	-	-	-	-	-	-	10
	-	-	-	-	-	-	0.8
f.	-	55	63	64	82	78	70
	-	6.3	6.3	5.5	7.0	6.7	5.5
g.	-	55	-	78	-	90	82
	-	6.3	-	6.8	-	7.7	6.5
16.	-	100	-	-	-	-	-
	-	11.5	-	-	-	-	-
17.	83	120	133	180	174	180	180
	13.0	13.8	13.3	15.6	14.9	15.4	14.2
18.	20	27	32	36	38	40	39
	3.1	3.2	3.2	3.1	3.3	3.4	3.1
19.	-	-	-	-	-	-	30
	-	-	-	-	-	-	2.4
20.	-	35	43	56	-	55	58
	-	4.0	4.3	4.8	-	4.7	4.6

1) Bar indicates no datum

2) Number at anterior base of flipper

(Continued)

Appendix II. (Continued)

19	764	1052	423	1207	126	607	123	239	1539
15xii67	26i68	3ii68	5i68	10ii68	20xii67	15i68	20xii67	23xii67	25ii68
15.2	15.2	14.8	15.9	15.2	15.4	16.1	15.2	15.0	14.7
-	50	51	53	49	53	53	51	54	58
1,290	1,320	1,510	1,545	1,570	1,570	1,710	1,710	1,790	1,840
-	-	-	13	-	-	-	-	-	16
-	-	-	0.8	-	-	-	-	-	0.9
-	165	180	197	195	200	208	230	245	215
-	12.5	11.9	12.8	12.4	12.7	12.2	13.5	13.7	11.7
-	34	40	44	50	-	48	-	-	55
-	2.6	2.6	2.8	3.2	-	2.8	-	-	3.0
-	275	-	310	325	330	345	368	390	360
-	20.8	-	20.1	20.7	21.0	20.2	21.5	21.8	19.6
-	-	-	-	270	-	-	-	-	300
-	-	-	-	17.2	-	-	-	-	16.3
-	240	275	293	280	300	318	335	350	325
-	18.2	18.2	19.0	17.8	19.1	18.6	19.6	19.6	17.7
-	594	635	693	690	725	780	773	795	790
-	45.0	42.1	44.9	43.9	46.2	45.6	45.2	44.4	42.9
-	103	95	112	103	-	122	-	-	120
-	7.8	6.3	7.2	6.6	-	7.1	-	-	6.5
384	372	455	448	465	470	497	500	530	520
29.8	28.2	30.1	29.0	29.6	29.9	29.1	29.2	29.6	28.3
132	154	170	188	180	200	195	180	200	170
10.2	11.7	11.3	12.0	11.5	12.7	11.4	10.5	11.1	9.2
-	-	-	-	-	-	-	-	-	200
-	-	-	-	-	-	-	-	-	10.9
290	273	330	-	340	320	235	380	420	390
22.5	20.7	21.9	-	21.7	20.4	13.7	22.2	23.5	21.2
360	375	425	420	450	475	470	470	500	530
27.9	28.4	28.1	27.2	28.7	30.3	27.5	27.5	27.9	28.8
-	615	710	707	740	735	815	785	800	890
-	46.6	47.0	45.8	47.1	46.8	47.7	45.9	44.7	48.4
-	720	810	775	850	835	923	895	890	950
-	54.5	53.6	50.2	54.1	53.2	54.0	52.3	49.7	51.6
-	95	90	94	100	115	122	115	120	115
-	7.2	6.0	6.1	6.4	7.3	7.1	6.7	6.7	6.3
38	48	45	61	60	70	69	-	-	56
2.9	3.6	3.0	3.9	3.8	4.5	4.0	-	-	3.0
-	98	85	100	105	-	-	-	-	130
-	7.2	5.6	6.5	6.7	-	-	-	-	7.1
-	-	-	-	23	-	-	-	-	20
-	-	-	-	1.5	-	-	-	-	1.1
-	94	95	103	115	120	125	-	-	117
-	7.1	6.3	6.9	7.3	7.6	7.3	-	-	6.4
99	104	110	120	125	-	147	-	-	128
7.7	7.9	7.3	7.8	8.0	-	8.6	-	-	7.0
-	-	140	-	175	-	-	-	-	195
-	-	9.3	-	11.1	-	-	-	-	10.6
-	200	200	-	227	230	270	245	260	260
-	15.2	13.3	-	14.5	14.6	15.8	14.3	14.5	14.1
-	43	47	-	50	56	54	55	58	56
-	3.3	3.1	-	3.2	3.6	3.2	3.2	3.2	3.6
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	62	65	70	80	80	70	92	-	85
-	4.7	4.3	4.5	5.1	5.1	4.1	5.4	-	4.6

(Continued)

Appendix II. (Continued)

845	1075	948	303	1533	485	1133	986	995	758	1516
28i68	5ii68	31i68	28xii67	25ii68	9i68	8ii68	1ii68	1ii68	26i68	24ii68
14.3	15.2	16.1	16.0	15.0	15.9	14.4	14.2	14.3	15.8	16.3
49	49	52	49	60	63	55	43	62	53	59
1,880	1,880	1,910	1,918	1,950	1,975	2,020	2,030	2,120	2,260	2,290
22	-	-	14	-	18	-	-	-	-	-
1.2	-	-	0.7	-	0.9	-	-	-	-	-
224	225	237	231	230	252	245	260	255	262	295
11.9	12.0	12.4	12.0	11.8	12.8	12.1	12.8	12.0	11.6	12.9
57	57	46	-	62	55	75	65	68	65	75
3.0	3.0	2.4	-	3.2	2.8	3.7	3.2	3.2	2.9	3.3
370	370	393	385	390	405	420	420	385	445	490
19.7	19.7	20.6	20.1	20.0	20.5	20.8	20.7	18.2	19.7	21.4
-	310	348	-	330	-	350	380	375	-	410
-	16.5	18.2	-	16.9	-	17.3	18.7	17.7	-	17.9
335	335	350	358	340	367	360	370	-	407	430
17.8	17.8	18.3	18.7	17.4	18.6	17.8	18.2	-	18.0	18.8
840	820	835	858	850	882	920	950	920	965	1,030
44.7	43.6	43.7	44.7	43.6	44.7	45.5	46.8	43.4	42.7	45.0
128	123	145	-	120	130	130	145	140	150	150
6.8	6.5	7.6	-	6.2	6.6	6.4	7.1	6.6	6.7	6.6
-	460	545	575	560	545	610	570	595	635	650
-	24.5	28.5	30.0	28.7	27.6	30.2	28.1	28.1	28.1	28.4
215	193	190	220	200	204	240	225	350	225	240
11.4	10.4	9.9	11.5	10.3	10.3	11.9	11.1	11.1	10.0	10.5
-	-	-	-	230	-	-	-	-	-	270
-	-	-	-	11.8	-	-	-	-	-	11.8
375	440	375	425	440	360	430	375	395	460	360
19.9	23.4	19.6	22.2	22.6	18.4	21.3	18.5	18.6	20.4	15.7
553	550	530	528	550	575	545	525	600	615	640
29.4	29.3	27.7	27.5	28.2	29.1	27.0	25.9	28.3	27.2	27.9
890	910	880	905	895	900	920	900	1,010	1,105	1,090
47.3	48.4	46.1	47.2	45.9	45.6	45.5	44.3	47.6	48.9	47.6
1,010	1,030	995	1,022	980	1,069	1,050	1,000	1,090	1,210	1,190
53.7	54.8	52.1	53.3	50.3	53.9	52.0	49.3	51.4	53.5	52.0
122	135	115	130	135	123	135	125	145	140	160
6.5	7.2	6.0	6.8	6.9	6.2	6.7	6.2	6.8	6.2	7.0
70	65	60	87	90	90	90	65	80	115	85
3.7	3.5	3.1	4.5	4.6	4.6	4.5	3.2	3.8	5.1	3.7
125	130	120	-	130	135	140	112	150	175	140
6.6	6.9	6.3	-	6.7	6.8	6.9	5.5	7.0	7.7	6.1
-	25	30	-	30	-	-	40	35	-	35
-	1.3	1.6	-	1.5	-	-	2.0	1.7	-	1.5
130	140	130	162	145	160	155	135	165	170	175
6.9	7.4	6.8	8.4	7.4	8.1	7.7	6.7	7.8	7.5	7.6
145	155	160	-	170	-	170	180	180	188	195
7.7	8.2	8.4	-	8.7	-	8.4	8.9	8.5	8.3	8.5
-	197	-	-	200	-	225	-	-	-	240
-	10.5	-	-	10.3	-	11.1	-	-	-	10.5
268	274	277	286	300	307	320	308	310	328	350
14.3	14.6	14.5	14.9	15.4	15.5	15.8	15.2	14.6	14.5	15.3
61	55	58	64	63	59	65	67	70	72	75
3.2	2.9	3.0	3.3	3.2	3.0	3.2	3.3	3.3	3.2	3.3
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
90	-	73	95	87	85	105	-	105	100	90
4.8	-	3.8	5.0	4.5	4.3	5.2	-	5.0	4.4	3.9

(Continued)

Appendix II. (Continued)

1018	759	892	950	1734	1488	1050	1446	1399	1699	1749
2ii68	26i68	30i68	31i68	7iii68	23ii68	3ii68	22ii68	21ii68	6iii68	10iii68
14.5	14.8	16.5	15.1	15.8	14.5	14.6	14.9	15.9	16.8	15.6
52	46	58	50	—	56	45	47	60	54	59
2,320	2,350	2,430	2,440	2,630	2,660	2,740	2,770	3,030	3,260	3,550
—	—	—	—	—	—	30	22	—	—	—
—	—	—	—	—	—	1.1	0.8	—	—	—
275	287	302	290	320	310	325	345	380	370	450
11.9	12.2	12.4	11.9	12.2	11.7	11.9	12.5	12.5	11.3	12.7
73	76	80	62	80	80	87	80	85	110	110
3.1	3.2	3.3	2.7	3.0	3.0	3.2	2.9	2.8	3.4	3.1
—	460	490	465	540	—	550	570	600	660	690
—	19.6	20.2	19.1	20.5	—	20.1	20.6	19.8	20.2	19.4
—	—	—	400	460	—	490	470	520	560	600
—	—	—	16.4	17.5	—	17.9	17.0	17.2	17.2	16.9
420	425	458	—	470	460	495	480	530	555	600
18.1	18.1	18.8	—	17.9	17.3	18.1	17.3	17.5	16.9	16.9
1,030	1,036	1,105	1,090	1,170	1,140	1,240	1,180	1,340	1,420	1,520
44.4	44.1	45.5	44.7	44.5	42.9	45.3	42.6	44.2	43.6	42.8
157	155	164	162	173	165	175	175	183	205	210
6.8	6.6	6.7	6.6	6.6	6.2	6.4	6.3	6.0	6.3	5.9
670	660	710	740	830	750	800	790	890	1,010	1,050
28.9	28.1	29.2	30.3	31.6	35.7	29.2	28.5	29.4	31.0	29.6
250	230	280	270	240	220	290	320	310	300	340
10.8	9.8	11.5	11.1	9.1	8.3	10.6	11.6	10.2	9.2	9.6
—	—	—	—	315	300	—	250	370	390	440
—	—	—	—	12.0	11.3	—	9.0	12.2	12.0	12.4
—	470	450	480	560	530	440	510	620	650	820
—	20.0	18.5	19.7	21.3	19.9	16.1	18.4	20.5	19.9	23.1
660	690	675	710	690	720	800	760	895	830	1,090
28.4	29.4	27.8	29.1	26.2	27.1	29.2	27.4	29.5	25.5	30.7
1,120	1,110	1,110	1,145	1,190	1,210	1,320	1,230	1,430	1,360	1,800
48.3	47.2	45.7	46.9	45.2	45.5	48.2	44.4	47.2	41.7	50.7
1,280	1,240	1,240	1,255	1,260	1,440	1,530	1,340	1,590	1,510	1,940
55.2	52.8	51.0	51.4	47.9	54.1	55.8	48.4	52.5	46.3	54.6
155	160	170	165	170	—	165	175	190	200	260
6.7	6.9	7.0	6.8	6.5	—	6.0	6.3	6.3	6.1	7.3
97	100	87	80	100	115	130	105	120	135	147
4.2	4.3	3.6	3.3	3.8	4.3	4.7	3.8	4.0	4.1	4.1
180	230	160	135	180	180	250	200	230	260	290
7.8	9.8	6.5	5.5	6.8	6.8	9.1	7.2	7.6	8.0	8.2
—	—	—	—	50	40	40	55	65	60	75
—	—	—	—	1.7	1.5	1.5	2.0	2.1	1.8	2.1
190	205	163	164	190	200	240	193	250	275	280
8.2	8.7	6.7	6.7	7.2	7.5	8.8	7.0	8.3	8.4	7.9
—	—	170	192	210	220	250	210	290	315	315
—	—	7.0	7.9	8.0	8.3	9.1	7.6	9.6	9.7	8.9
—	—	—	—	280	280	320	270	330	360	380
—	—	—	—	10.6	10.5	11.7	9.7	10.9	11.0	10.7
345	359	388	390	390	390	427	400	500	505	540
14.9	15.3	16.0	16.0	14.8	14.7	15.6	14.4	16.5	15.5	15.2
77	75	79	78	85	185	88	82	103	110	118
3.3	3.2	3.3	3.2	3.2	3.2	3.2	3.0	3.4	3.4	3.3
—	—	—	—	—	—	—	—	—	70	80
—	—	—	—	—	—	—	—	—	2.1	2.3
—	85	—	92	100	110	106	115	105	115	—
—	3.6	—	3.7	3.8	4.1	3.9	4.2	3.5	3.5	—

Appendix III. External measurements and percent body proportions for the foetuses of female sei whales. December 18, 1967-March 6, 1968. Antarctic. For measurements see Table 1 and Appendix I.¹⁾

Whale number	121	465	240	416	173	163	150
Date of catch	20xii67	7i68	23xii67	5i68	21xii67	21xii67	21xii67
Body length(m)	15.8	15.8	15.4	15.1	15.8	14.8	15.2
No. of Ventral grooves ²⁾	49	38	—	—	48	48	41
Measurements							
1.	1,000	1,053	1,070	1,080	1,130	1,170	1,230
2.	—	7	25	0	—	—	—
	—	0.7	2.3	0.0	—	—	—
3.	120	137	155	134	150	140	155
	12.0	13.0	14.5	12.4	13.3	12.0	12.6
a.	—	25	—	26	—	—	—
	—	2.4	—	2.4	—	—	—
4.	210	225	255	225	245	250	265
	21.0	21.4	23.8	20.8	21.7	21.4	21.5
b.	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
5.	185	205	235	195	220	215	230
	18.5	19.5	22.0	18.1	19.5	18.4	18.7
6.	435	480	545	490	535	540	550
	43.5	45.6	50.9	45.4	47.3	46.2	44.7
7.	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
8.	—	297	330	305	335	330	350
	—	28.2	30.8	28.2	29.6	28.2	28.5
9.	120	113	95	125	140	145	140
	12.0	10.7	8.9	11.6	12.4	12.4	11.4
c.	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
d.	210	95 ?	—	175	240	220	220
	21.0	9.5?	—	16.2	21.2	18.8	17.9
10.	280	290	250	298	320	335	360
	28.0	27.5	23.4	27.6	28.3	28.6	29.3
11.	475	477	—	510	525	550	590
	47.5	45.3	—	47.2	46.5	47.0	48.0
12.	600	564	—	605	650	635	675
	60.0	53.6	—	56.0	57.5	54.3	54.9
13.	20	23	25	23	—	25	25
	2.0	2.2	2.3	2.1	—	2.1	2.0
14.	40	35	30	35	45	40	38
	4.0	3.3	2.8	3.2	4.0	3.4	3.1
15.	—	65	—	75	—	—	—
	—	6.2	—	6.9	—	—	—
e.	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
f.	68	67	70	69	75	80	75
	6.8	6.4	6.5	6.4	6.6	6.8	6.1
g.	78	—	—	—	85	93	91
	7.8	—	—	—	7.5	7.9	7.7
16.	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
17.	144	162	140	158	165	175	—
	14.4	15.4	13.1	14.6	14.6	15.0	—
18.	33	34	34	35	38	36	—
	3.3	3.2	3.2	3.2	3.4	3.1	—

1) Bar indicates no datum

2) Number at anterior base of flipper

(Continued)

Appendix III. (Continued)

1083	166	1081	260	354	104	222	1442	148	508
5ii68	21xii67	5ii68	25xii67	2i68	18xii67	23xii67	22ii68	21xii67	11i68
15.6	15.3	14.9	15.0	15.3	14.4	15.9	14.6	16.3	14.4
46	52	45	44	50	49	58	53	58	52
1,290	1,300	1,370	1,400	1,405	1,430	1,460	1,470	1,470	1,475
-	-	-	-	10	-	-	-	-	4
-	-	-	-	0.7	-	-	-	-	0.3
157	170	190	185	182	165	175	185	185	205
12.2	13.1	13.9	13.2	13.0	11.5	12.0	12.6	12.6	13.9
34	-	40	-	-	-	-	33	-	37
2.6	-	2.9	-	-	-	-	2.2	-	2.5
265	280	320	300	308	300	300	300	310	325
20.5	21.5	23.4	21.4	21.9	21.0	20.5	20.4	21.1	22.0
215	-	265	-	-	-	-	255	-	-
16.7	-	19.3	-	-	-	-	17.3	-	-
235	250	275	273	280	260	270	260	275	295
18.2	19.2	20.1	19.5	19.9	18.2	18.5	17.7	18.7	20.0
580	585	650	635	657	615	660	620	635	690
45.0	45.0	47.4	45.4	46.8	43.0	45.2	42.2	43.2	46.8
-	-	105	-	107	-	-	100	-	-
-	-	7.7	-	7.6	-	-	6.8	-	-
380	-	410	415	368	400	425	400	440	423
29.5	-	29.9	29.6	27.6	28.0	29.1	27.2	29.9	28.7
150	170	155	160	150	155	160	160	185	170
11.6	13.1	11.3	11.4	10.7	10.8	11.0	10.9	12.6	11.5
-	-	-	-	-	-	-	170	-	-
-	-	-	-	-	-	-	11.6	-	-
245	260	260	280	280	290	290	300	-	295
19.0	20.0	19.0	20.0	19.9	20.3	19.9	20.4	-	20.0
365	365	375	390	390	420	420	425	440	438
28.3	28.1	27.4	27.9	27.8	29.4	28.8	28.9	29.9	29.7
605	600	590	635	625	655	690	695	720	700
46.9	46.2	43.1	45.4	44.5	45.8	47.3	47.3	49.0	47.5
710	690	720	750	705	790	780	780	820	775
55.0	53.1	52.6	53.6	50.2	55.2	53.4	53.1	55.8	52.5
30	-	25	30	29	30	40	28	35	28
2.3	-	1.8	2.1	2.1	2.1	2.7	1.9	2.4	1.9
43	65	47	55	48	58	60	50	53	58
3.3	5.0	3.4	3.9	3.4	4.1	4.1	3.4	3.6	3.9
85	-	75	-	87	-	-	100	-	90
6.6	-	5.5	-	6.2	-	-	6.8	-	6.1
20	-	-	-	-	-	-	20	-	-
1.6	-	1.5	-	-	-	1.4	-	-	-
80	105	100	85	96	95	110	103	105	102
6.2	8.1	7.3	6.1	6.8	6.6	7.5	7.0	7.1	6.9
90	105	110	100	110	102	-	125	130	128
7.0	8.1	8.0	7.1	7.8	7.1	-	8.5	8.8	8.7
130	-	150	-	-	-	-	160	-	-
10.1	-	10.9	-	-	-	-	10.9	-	-
180	190	205	200	216	195	220	210	200	228
14.0	14.6	15.0	14.3	15.4	13.6	15.1	14.3	13.6	15.5
43	40	44	40	44	45	50	40	45	47
3.3	3.0	3.2	2.9	3.1	3.1	3.4	2.7	3.1	3.2

(Continued)

Appendix III. (Continued)

156	1403	1291	944	110	1178	893	469	1112	1082	1242
21xii67	21ii68	16ii68	31i68	19xii68	9ii68	30i68	7i68	7ii68	5ii68	12ii68
14.8	15.0	14.4	13.4	15.6	14.8	15.7	17.6	14.0	14.5	15.7
52	43	52	52	61	57	53	48	49	46	58
1,620	1,710	1,750	1,750	1,805	1,830	1,840	1,965	2,010	2,010	2,160
-	-	-	-	-	-	5	18	-	15	15
-	-	-	-	-	-	0.3	0.9	-	0.7	0.7
215	210	215	220	225	225	245	258	250	255	280
13.3	12.3	12.3	12.6	12.5	12.3	13.3	13.1	12.4	12.7	13.0
-	55	54	50	-	55	47	57	50	55	65
-	3.2	3.1	2.9	-	3.0	2.5	2.9	2.5	2.7	3.0
365	380	370	370	360	380	-	423	420	440	460
22.5	22.2	21.1	21.1	19.9	20.8	-	21.5	20.9	21.9	21.3
-	315	310	340	-	320	327	-	360	360	380
-	18.4	17.7	19.4	-	17.5	17.8	-	17.9	17.9	17.6
330	330	325	340	330	330	348	377	377	-	400
20.4	19.3	18.6	19.4	18.3	18.0	18.9	19.2	18.8	-	18.5
745	790	770	790	800	800	830	887	885	930	975
46.0	46.2	44.0	45.1	44.3	43.7	45.1	45.1	44.0	46.3	45.1
-	123	113	123	-	130	134	-	135	142	146
-	7.2	6.5	7.0	-	7.1	7.3	-	6.7	7.1	6.8
490	490	530	505	565	500	530	558	600	550	640
30.2	28.7	30.3	28.9	31.3	27.3	28.8	28.4	29.9	27.4	29.6
215	160	190	180	200	195	200	-	230	230	190
13.3	9.4	10.9	10.3	11.1	10.7	10.9	-	11.4	11.4	8.8
-	200	180	-	-	-	-	210	-	-	-
-	11.7	10.3	-	-	-	-	10.7	-	-	-
390	390	330	295	320	440	380	-	340	510	390
24.1	22.8	18.9	16.9	17.7	24.0	20.7	-	16.9	25.4	18.1
465	490	525	485	545	490	490	575	605	560	580
28.7	28.7	30.0	27.7	30.2	26.8	26.6	29.3	30.1	27.9	26.9
770	800	820	790	875	820	815	935	940	930	980
47.5	46.8	46.9	45.1	48.5	44.8	44.3	47.6	46.8	46.3	45.4
870	910	920	880	980	930	910	1,065	1,060	1,040	1,110
53.7	53.2	52.6	50.3	54.3	50.8	49.5	54.2	52.7	51.7	51.4
35	35	35	30	43	37	44	43	-	40	50
2.2	2.0	2.0	1.7	2.4	2.0	2.4	2.2	-	2.0	2.3
85	60	65	84	80	65	80	68	55	80	70
5.2	3.5	3.7	4.8	4.4	3.6	4.3	3.5	2.7	4.0	3.2
-	110	110	110	-	130	120	140	110	130	140
-	6.4	6.3	6.3	-	7.1	6.5	7.1	5.5	6.5	6.5
-	20	30	-	-	35	-	-	30	-	40
-	1.2	1.7	-	-	1.9	-	-	1.5	-	1.9
120	120	130	147	133	140	148	149	130	160	165
7.4	7.0	7.4	8.4	7.4	7.7	8.0	7.6	6.5	8.0	7.6
130	130	145	167	-	160	-	-	150	200	195
8.0	7.6	8.3	9.5	-	8.7	-	-	7.5	10.0	9.0
-	190	185	-	-	185	-	-	210	230	230
-	11.1	10.6	-	-	10.1	-	-	10.4	11.4	10.6
235	250	260	260	265	262	276	282	280	315	330
14.5	14.6	14.9	14.9	14.7	14.3	15.0	14.4	13.9	15.7	15.3
53	55	54	61	59	60	61	63	61	65	70
3.3	3.2	3.1	3.5	3.3	3.3	3.3	3.2	3.0	3.2	3.2

(Continued)

Appendix III. (Continued)

1487	1059	1545	1547	998	1216	996	952	1019	1248	1076
23ii68	4ii68	26ii68	26ii68	1ii68	10ii68	1ii68	31ii68	2ii68	13ii68	5ii68
15.8	14.9	15.4	13.7	13.8	15.0	14.5	15.1	14.7	15.0	16.0
56	66	-	51	-	60	64	51	-	63	50
2,250	2,260	2,300	2,370	2,440	2,450	2,510	2,640	2,670	2,730	2,810
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
290	275	-	290	-	300	330	333	350	335	330
12.9	12.3	-	12.2	-	12.2	13.1	12.6	13.1	12.3	11.7
70	72	-	74	-	90	90	85	88	90	85
3.1	3.2	-	3.1	-	3.7	3.6	3.2	3.3	3.3	3.0
480	470	-	515	510	500	540	550	550	560	560
21.3	21.0	-	21.7	20.9	20.4	21.5	20.8	20.6	20.5	19.9
410	405	-	445	440	420	460	500	480	460	470
18.2	18.1	-	18.8	18.0	17.1	18.3	18.9	18.0	16.8	16.7
430	415	-	460	467	440	475	505	505	485	495
19.1	18.5	-	19.4	19.1	18.0	18.9	19.1	18.9	17.8	17.6
1,010	1,020	-	1,090	1,110	1,080	1,135	1,200	1,245	1,230	1,240
44.9	45.5	-	46.0	45.5	44.1	45.2	45.5	46.6	45.1	44.1
150	150	-	155	167	160	175	154	180	180	175
6.7	6.7	-	6.5	6.8	6.5	7.0	5.8	6.7	6.6	6.2
690	620	710	670	670	720	750	780	810	790	780
30.7	27.7	30.9	28.3	27.5	29.4	29.9	29.5	30.3	28.9	27.8
200	250	200	215	270	260	270	290	280	300	290
8.9	11.1	8.7	9.1	11.1	10.6	10.8	11.6	10.5	11.0	10.3
275	-	240	270	-	-	-	390	-	-	-
12.2	-	10.4	11.4	-	-	-	14.8	-	-	-
400	590	-	420	570	570	550	-	-	490	580
17.8	26.3	-	17.7	23.4	23.3	21.9	-	-	17.9	20.6
575	640	720	675	670	700	700	720	805	800	830
25.6	28.4	31.3	28.5	27.5	28.6	27.9	27.3	30.1	29.3	29.5
930	1,040	1,110	1,110	1,130	1,120	1,190	1,160	1,305	1,250	1,380
41.3	46.4	47.8	46.4	46.3	45.7	47.4	43.9	48.9	45.8	49.1
1,060	1,100	1,200	1,240	1,250	1,240	1,315	1,340	1,430	1,440	1,480
47.1	49.1	52.2	52.3	51.2	50.6	52.4	50.8	53.6	52.7	52.7
-	50	65	55	55	55	60	55	65	50	55
-	2.2	2.8	2.3	2.3	2.2	2.4	2.1	2.4	1.8	2.0
90	90	-	80	95	110	90	115	90	110	140
4.0	4.0	-	3.4	3.9	4.5	3.6	4.4	3.4	4.0	5.0
130	150	-	170	180	170	185	190	180	220	200
5.8	6.7	-	7.2	7.4	6.9	7.3	7.2	6.7	8.1	7.1
40	-	-	50	40	35	-	-	-	60	40
1.8	-	-	2.1	1.6	1.4	-	-	-	2.2	1.4
165	185	-	195	180	205	210	220	205	240	235
7.3	8.3	-	8.2	7.4	8.4	8.4	8.3	7.7	8.8	8.4
190	220	-	215	195	230	240	-	235	280	250
8.4	9.8	-	9.1	8.0	9.4	9.6	-	8.8	10.3	8.9
240	235	-	265	-	270	-	-	-	330	280
10.7	10.5	-	11.2	-	11.0	-	-	-	12.1	10.0
345	330	-	370	380	360	395	420	455	450	430
15.3	14.7	-	15.6	15.6	14.7	15.7	15.9	17.0	16.5	15.3
77	65	-	79	82	80	85	88	92	95	90
3.4	2.9	-	3.3	3.4	3.3	3.4	3.3	3.4	3.5	3.2

(Continued)

Appendix III. (Continued)

1400	1251	1293	1549	1209	1246	1107	1484	1537	1483	1697
21ii68	13ii68	16ii68	26ii68	10ii68	13ii68	6ii68	23ii68	25ii68	23ii68	6iii68
15.8	15.9	15.4	16.0	15.4	15.3	15.3	15.8	15.1	16.4	14.9
58	62	47	50	58	63	63	63	60	55	58
2,810	2,870	2,890	3,080	3,100	3,170	3,200	3,220	3,270	3,380	3,660
13	25	-	17	15	-	-	-	-	25	-
0.5	0.9	-	0.6	0.5	-	-	-	-	0.7	-
350	350	360	385	350	370	380	405	400	380	420
12.5	12.2	12.5	12.5	11.3	11.7	11.9	12.6	12.2	11.2	11.5
95	87	95	105	105	110	95	100	95	90	120
3.4	3.0	3.3	3.4	3.4	3.5	3.0	3.1	2.9	2.7	3.3
610	570	610	650	600	620	670	660	660	640	710
21.7	19.9	21.1	21.1	19.4	19.6	20.9	20.5	20.2	18.9	19.4
520	490	520	560	510	530	550	580	560	540	600
18.5	17.1	18.0	18.2	16.5	16.7	17.2	18.0	17.1	16.0	16.4
530	510	530	560	530	565	580	590	575	560	620
18.9	17.8	18.3	18.2	17.1	17.8	18.1	18.3	17.6	16.6	16.9
1,290	1,260	1,310	1,415	1,320	1,390	1,400	1,460	1,400	1,430	1,540
45.9	43.9	45.3	45.9	42.6	43.8	43.8	45.3	42.8	42.3	42.1
175	183	186	200	207	195	200	205	210	197	218
6.2	6.4	6.4	6.5	6.7	6.2	6.3	6.4	6.4	5.8	6.0
800	850	820	940	950	910	930	930	1,030	1,020	1,200
28.5	29.6	28.4	30.5	30.6	28.7	29.1	28.9	31.5	30.2	32.8
260	280	270	270	310	330	330	280	310	330	330
9.3	9.8	9.3	8.8	10.0	10.4	10.3	8.7	9.5	9.8	9.0
330	-	-	340	-	-	-	420	320	460	350
11.7	-	-	11.0	-	-	-	13.0	9.8	13.6	9.6
550	520	630	470	800	500	550	600	430	680	560
19.6	18.1	21.8	15.3	25.8	15.8	17.2	18.6	13.1	20.1	15.3
800	850	790	870	930	960	940	920	1,050	980	910
28.5	29.6	27.3	28.2	30.0	30.3	29.4	28.6	32.1	29.0	24.9
1,280	1,370	1,260	1,420	1,480	1,570	1,570	1,540	1,570	1,570	1,525
45.6	47.7	43.6	46.1	47.7	49.5	49.1	47.8	48.0	46.4	41.7
1,440	1,410	1,420	1,550	1,600	1,690	1,780	1,670	1,750	1,780	1,620
51.2	49.1	49.1	50.3	51.6	53.3	55.6	51.9	53.5	52.7	44.3
40	65	55	65	60	65	75	70	70	75	70
1.4	2.3	1.9	2.1	1.9	2.1	2.3	2.2	2.1	2.2	1.9
93	120	105	95	110	170	150	130	110	145	130
3.3	4.2	3.6	3.1	3.5	5.4	4.7	4.0	3.4	4.3	3.6
180	220	210	210	220	270	280	270	210	280	270
6.4	7.7	7.3	6.8	7.1	8.5	8.8	8.4	6.4	8.3	7.4
55	60	45	65	40	45	50	75	40	60	80
2.0	2.1	1.6	2.1	1.3	1.4	1.6	2.3	1.2	1.8	2.2
220	230	210	225	225	280	270	310	230	290	280
7.8	8.0	7.3	7.3	7.3	8.8	8.4	9.6	7.0	8.6	7.6
255	260	230	320	240	300	300	370	250	310	315
9.1	9.1	8.0	10.4	7.7	9.5	9.4	11.5	7.6	9.2	8.6
310	310	330	360	330	360	350	330	340	360	375
11.0	10.8	11.4	11.7	10.6	11.4	10.9	10.2	10.4	10.7	10.2
450	430	470	510	470	500	515	515	480	520	550
16.0	15.0	16.3	16.6	15.2	15.8	16.1	16.0	14.7	15.4	15.0
88	95	105	104	102	108	105	100	100	108	115
3.1	3.3	3.6	3.4	3.3	3.4	3.2	3.1	3.1	3.2	3.1